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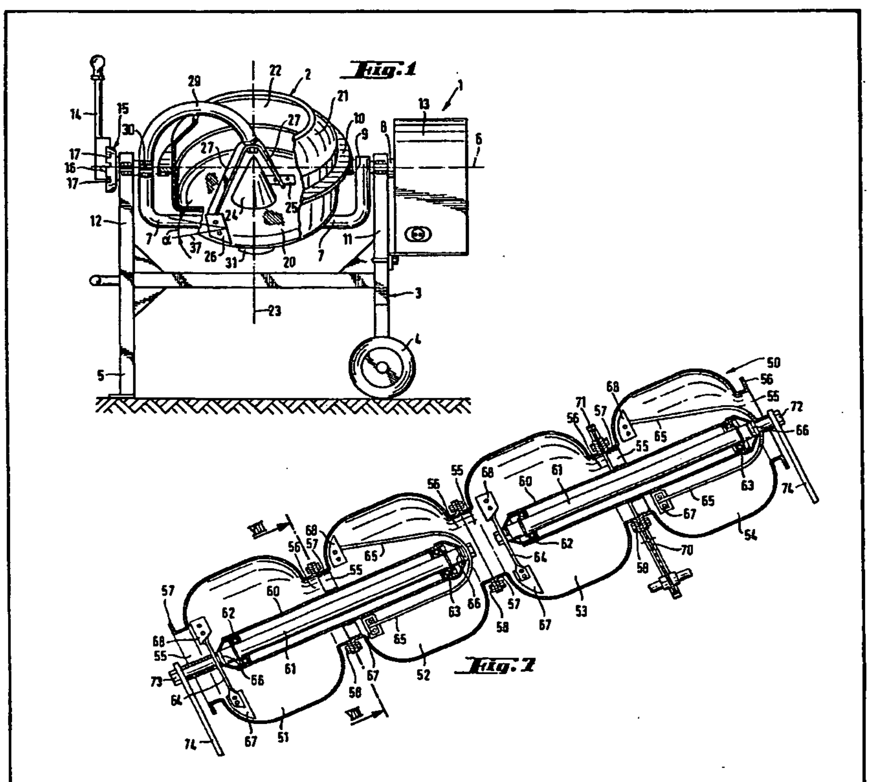
(54) Mixer

(57) A mixer, particularly for building materials, comprises at least one drum-shaped mixing vessel 2, which is mounted for rotation about its center line 23 in a bearing 10 on a carrier 7, and a mixing mechanism disposed in the interior of the mixing vessel. A rotationally symmetrical hollow body 24 is disposed in the interior of the mixing vessel 2 on the bottom 10 thereof and is concentric to the center line of the mixing vessel. At least one mixing blade 25 is disposed near the outside surface of the rotationally symmetrical hollow body and of the bottom 10 of the mixing vessel and at least one additional mixing blade 26 is disposed near the inside surface of the mixing vessel 2. In a further embodiment a plurality of mixing vessels 51, 52, 53 and 54 are provided for rotation about a common axis, each vessel having its respective mixing blades 67, 68 situated as indicated above.



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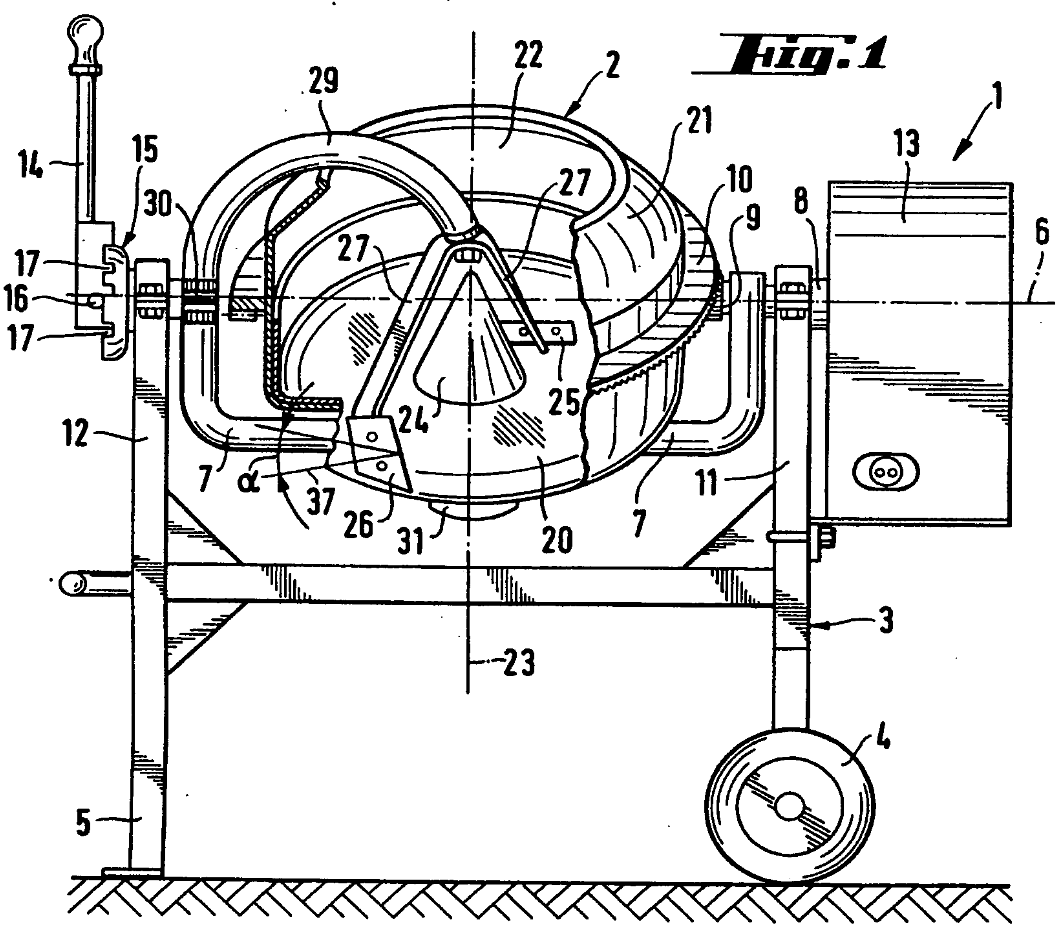


Fig. 1

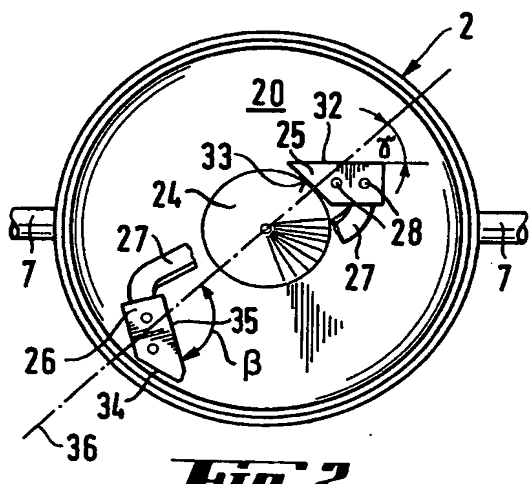


Fig. 2

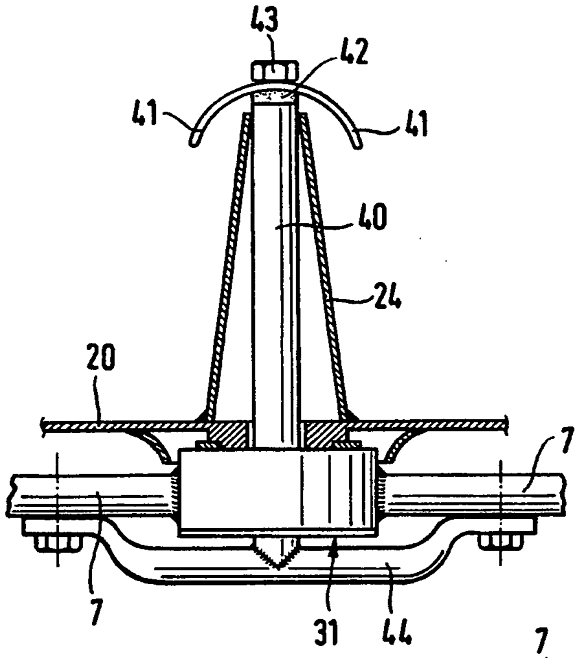
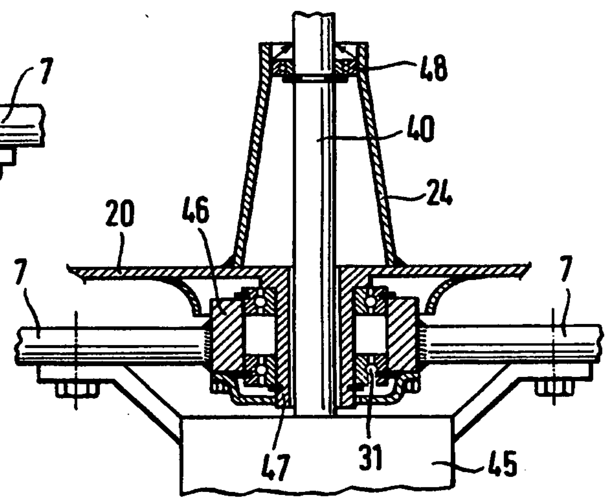


Fig. 3

Fig. 4



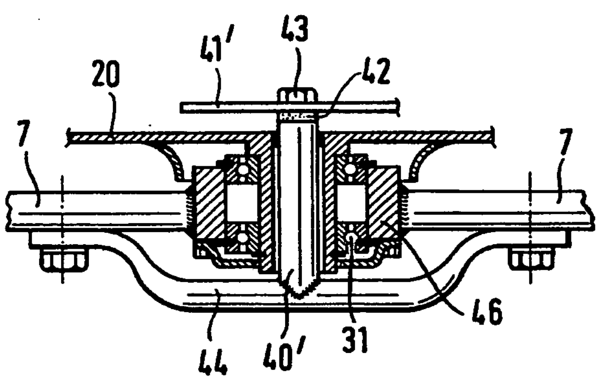
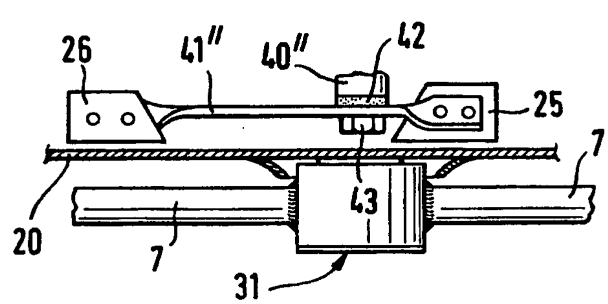


Fig. 5

Fig. 6



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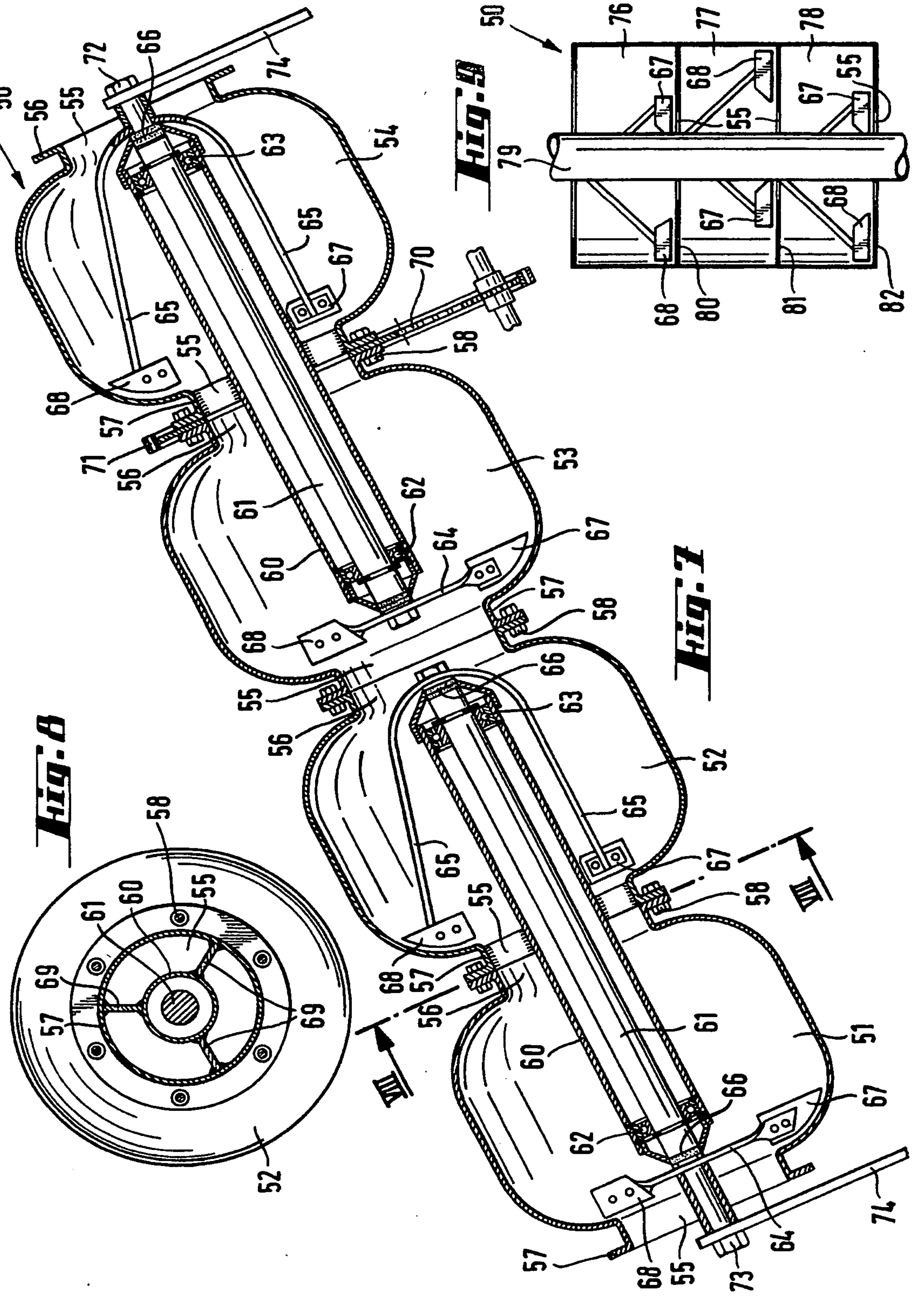

Fig. 7

Fig. 8

Fig. 9

SPECIFICATION

Mixer

This invention relates to a mixer, particularly for building materials, comprising at least one drum-shaped mixing vessel, which is mounted for rotation about its center line in a bearing on a carrier, and a mixing mechanism disposed in the interior of the mixing vessel.

A mixer of the kind mentioned first hereinbefore usually comprises a mixing mechanism consisting of blades which are disposed on the inside peripheral surface of the mixing vessel, which rotates about its center line. It has been found, however, that a mixing mechanism comprising blades on the rotating mixing vessel cannot always effect a satisfactory mixing of the materials which have been fed into the mixing vessel and are to be mixed therein. In dependence on the consistency of the materials to be mixed, such as building materials which have become moist, these materials may form lumps unless they are adequately mixed. Such lumps will adversely affect the quality and usability of the mixture which is prepared in the mixer. For a uniform and intense mixing, the mixing vessel must perform a very large number of revolutions so that a mixing operation can be completed only within a long time. Because the mixer must be driven throughout the mixing operation, a relatively large amount of energy is required too. For this reason the known mixer is not sufficiently economical and, in particular, is unable to mix the several materials as thoroughly as is desired.

For this reason it is an object of the present invention so to improve a mixer of the kind mentioned first hereinbefore that a uniform and intense mixing is enabled in an economical manner. In particular, the energy consumption should be taken into account too and should be strongly reduced, if possible. At the same time, it is to be ensured that a mixer for an intense and uniform mixing and for an energy-saving operation is to be as simple in design as possible so that it is suitable for mass production.

Accordingly the present invention provides a mixer having at least one drum-shaped mixing vessel, which is mounted for rotation about its center line in a bearing on a carrier, a mixing mechanism disposed in the interior of the mixing vessel, a rotationally symmetrical hollow body disposed in the interior of the mixing vessel on the bottom thereof and concentric to the center line of the mixing vessel, at least one mixing blade disposed near the outside surface of the rotationally symmetrical hollow body and near the bottom of the mixing vessel, and at least one additional mixing blade disposed near the inside surface of the mixing vessel.

In the mixer according to the invention the previous mixing mechanism consisting of blades on the inside surface of the mixing vessel is replaced by a rotationally symmetrical hollow body, which is disposed at the bottom of the mixing vessel, and at least two mixing blades. In such mixer the material being mixed, which is moving as a result of the rotation of the mixing vessel, is moved away from the rotationally symmetrical hollow body toward the inside surface of the mixing vessel by the mixing blade which is disposed near the outside surface of the rotationally symmetrical hollow body and near the bottom of the mixing vessel. The second mixing blade, which is disposed near the inside surface of the mixing vessel, reverses the material to be mixed and pushes it toward the center of the mixing vessel, i.e., toward the rotationally symmetrical hollow body. At the same time, the material being mixed which contacts the bottom portion disposed between the rotationally symmetrical hollow body and the inside surface of the mixing vessel is entrained and moved by rotating mixing vessel. This repeated circulation of the material being mixed during the mixing operation effected in the mixing vessel results in a highly intense mixing of the several ingredients so that a mixture of high quality is obtained by a relatively short mixing operation. Because a given degree of mixing can be obtained by a much shorter mixing operation than in the conventional mixing vessels less energy for driving the mixing vessel is required in each mixing operation so that energy is saved. As a result, the mixer according to the invention operates economically and permits a very thorough mixing of the several ingredients. By the selection of a suitable design of the mixing blades and the selection of a suitable speed of the mixing vessel, the mixer can readily be adapted to specific applications, in which it was difficult before to effect any satisfactory mixing of the ingredients by means of a conventional mixer. The speed of the mixing vessel can readily be selected in dependence on the consistency of the ingredients to be mixed so that the mixer according to the invention is highly versatile in use.

All basic embodiments of the mixer according to the invention have various details in common. The mixing blades are interconnected by a common connecting arm. The connecting arm consists preferably of a single piece of flat bar iron stock. Specifically, the preferably two mixing blades are directly secured to the connecting arm. This design of the means which connect the mixing blades results in a very simple structure of the entire mixer because a few components which are relatively simple in structure can be directly interconnected by means of screws. The assembling is also greatly facilitated by such an arrangement.

Very favorable mixing conditions and an extremely intense mixing will result if the outer edge of the mixing blade disposed near the outside surface of the rotationally symmetrical hollow body includes an angle of about 45° with a plane which extends through both mixing blades and the center line of the mixing vessel and if the inner edge of the mixing blade disposed near the inside surface of the mixing vessel includes an angle of about 120° with a plane which extends through both mixing blades and the center line of the mixing vessel. That edge of the mixing blade disposed near the inside surface of the mixing vessel which faces the inside surface of the mixing vessel has preferably an angle of about 23° to a tangent to the inside surface of the mixing vessel.

In a first embodiment of a mixer, there is only one mixing vessel and the mixing blades disposed in the mixing vessel are suitably stationary. This eliminates the need for complicated bearing means for the mixing blades and the connecting arm; such complicated bearing means would add to the manufacturing costs of a mixer. In that embodiment, the rotationally symmetrical hollow body consists of a cone and is fixed directly to the bottom of the mixing vessel, e.g., by welding. The common connecting arm which carries the mixing blades is curved in V-shaped and at its bottom is secured to a blade carrier, which constitutes an arcuately curved extension of the carrier for the mixing vessel. That blade carrier extends from the outside into the charging opening of the mixing vessel and serves to hold the mixing blades. In that embodiment, only four components are required to hold the mixing blades, namely, the arcuately curved blade carrier, the common connecting arm, and the mixing blades connected to said arm. These components can be assembled relatively quickly and may be made from conventional basic stock, such as flat iron bars, round iron bars or hollow sections.

The carrier for the mixing vessel is preferably mounted in a conventional manner on the machine frame to be pivotally movable together with the mixing vessel on a horizontal pivot, the axis of which preferably coincides with the axis of the drive shaft for rotating the mixing vessel, and a pinion is fixed to the drive shaft and in mesh with a ring gear that extends around the outside periphery of the mixing vessel. The angular position of the carrier for the mixing vessel and of the mixing vessel itself can be adjusted by means of a lever, which is secured to the horizontal pivot. By this adjustment, the charging and discharging operations can be facilitated and an additional effect can be achieved particularly in conjunction with the mixing blades provided according to the invention and the rotationally symmetrical hollow body. That additional effect resides in that optimum conditions under which specific ingredients to be mixed revolve can be adjusted by the selection of a suitable angular position of the mixing vessel and its carrier. Because in a mixing mechanism comprising blades disposed on the inside peripheral surface of the mixing vessel, the inclination of the latter has almost no influence on the degree of mixing, it was previously sufficient to provide means for locking the lever for adjusting the angular position of the mixing vessel in two positions, namely, a position, in which the mixing vessel is in a horizontal mixing position, and a position in which the mixing vessel is turned through 90° from said mixing position so that the contents of the mixing vessel can be discharged by gravity. If the mixing blades according to the invention and the rotationally symmetrical hollow body are used, the mixing conditions can be varied through a larger range if the lever connected to the horizontal pivot can be locked in several positions so that optimum mixing conditions can be selected.

In another basic embodiment of a mixer according to the invention, the mixing blades are rotatably mounted by means of the common connecting arm on a shaft which is at right angles to the bottom surface of the mixing vessel. To enable the use of bearing means which are as simple as possible, the shaft extends through the rotationally symmetrical hollow body and protrudes over its end, and the connecting arm is secured to the end with a shock absorber interposed, which consists preferably of a rubber element. In that embodiment the cavity that is enclosed by the rotationally symmetrical hollow body accommodates the bearing means for the shaft and the latter is accommodated so as to be protected against being soiled or the like. Because in this embodiment the connecting arm and the mixing blades secured to it can perform an additional rotary motion, the intensity of the mixing operation will be much improved. The connecting arm may rotate in the same sense as mixing vessel or in the opposite sense. This will depend on the specific conditions and on the the nature of the ingredients to be mixed.

In this embodiment, the rotationally symmetrical hollow body is suitably conical and is formed by a tubular member. That tubular member may be welded, e.g., to the bottom of the mixing vessel. In this way the design of the rotationally symmetrical hollow body will be further simplified.

The shaft which carries the connecting arm and the mixing blades secured to it may be driven by the main drive means for the mixer or by separate drive means, such as a speed-reducing transmission, so that the mixing vessel and the revolving mixing blades may revolve at different speeds. In this way the mixing operation can be further simplified.

The design of the bearing means for the shaft for rotating the connecting arm and the mixing blades will depend on the nature of the drive means. Those bearing means will be disposed near the main bearing for the mixing vessel. In dependence on the location of that common main bearing, the connecting arm will either be curved in hat-shape, with the blades carried by the connecting arm at its free ends, or the connecting arm is straight-lined. In an alternative embodiment, the shaft which carries the common connecting arm and the mixing blades secured thereto is self-supporting and disposed in the interior of the mixing vessel and the connecting arm is mounted on the shaft, with a shock absorber interposed, and is preferably straight-lined.

In the first embodiment comprising stationary mixing blades the curved blade carrier is also connected to the carrier for the mixing vessel adjacent to the horizontal pivot with a shock absorber interposed. Owing to these shock absorbers used in all embodiments of the invention, the blade which wipes over the bottom surface of the mixing vessel can be disposed as close as possible to said bottom surface and the mixing blades will not be damaged but owing to the shock absorbers can resiliently yield when the mixing blades approach or contact the bottom of the mixing vessel or when they impinge on obstacles, such as coarse stones.

In another embodiment of a mixer according to the invention, a plurality of mixing vessels are connected in series and interconnected by openings, a common cylindrical rotationally symmetrical hollow body extends through at least two successive mixing

vessels, and a shaft is rotatably mounted inside said body and carries at least two connecting arms provided with the mixing blades and is rotatably supported by means of bearings blades and is rotatably supported by means of bearings in the cylindrical rotationally symmetrical hollow body. In the plurality of mixing vessels connected in series, the charged material to be mixed is mixed in a plurality of stages arranged in series. In all mixing vessels and all mixing stages, the basic concept of the invention residing in the use of a rotationally symmetrical hollow body inside the mixing vessel and of mixing blades of the kind described hereinbefore is embodied and the arrangement may be such that there is no need for a separate rotationally symmetrical hollow body for each mixing vessel but a combined rotationally symmetrical hollow body may be provided for two or more mixing vessels. That feature will greatly simplify the design, the assembling and the manufacture of mixers having a plurality of mixing vessels. Besides, floor space may be saved in that embodiment because each mixing vessel need not be very large. Where a plurality of mixing vessels are connected in series, it will be sufficient to support the shaft only at its two outer ends by a carrying frame, e.g., on the floor.

Rotation to the assembly comprising a plurality of mixing vessels is preferably imparted from the outside in that driving torque is transmitted to the mixing vessels from a drive member preferably by means of a chain. By means of such chain drive the plurality of mixing vessels, which constitute a larger mass than a single mixing vessel, can be rotated uniformly, regularly and reliably.

The shafts carrying the connecting arms with the mixing blades are preferably driven by means which are separate from the main drive means of the overall arrangement. Individual or several mixing mechanisms of the mixing vessels may be driven by common or separate drive means so that different speeds can be selected for the mixing blades in the several mixing stages and optimum conditions in each mixing stage can thus be obtained.

In a very simple embodiment comprising a plurality of mixing vessels connected in series, the mixing vessels are cylindrical and the cylindrical rotationally symmetrical hollow body extends through all mixing vessels. In this embodiment, the basic concept of the invention may be carried into effect with a single cylindrical rotationally symmetrical hollow body. This will greatly simplify the design. Cylindrical mixing vessels connected in series are preferably made in that a cylindrical main vessel is divided into several cylindrical mixing vessels by means of a plurality of transverse partitions. This will eliminate the need for connecting several mixing vessels to each other but a plurality of cylindrical mixing vessels connected in series will be embodied in an integral structure. The several cylindrical mixing vessels are interconnected adjacent to the common cylindrical rotationally symmetrical hollow body by passage openings through which the material to be mixed can move from one mixing stage to another without need for additional measures.

In an alternative embodiment of an arrangement in which a plurality of mixing vessels are connected in series, the mixing vessels are drum-shaped and at their opposite ends comprise flangelike portions which are smaller in diameter and firmly interconnected by screws. In such an arrangement, the several mixing vessels constitute respective components, which can be interconnected in any desired sequence and number as may be required. The flanged joints between adjacent mixing vessels can be made and eliminated without difficulty so that this embodiment permits almost universal combinations.

Mixing vessels having portions smaller in diameter may be further simplified in design in that the cylindrical rotationally symmetrical hollow body is supported at the joint between two mixing vessels by radial ribs, which are secured to the cylindrical rotationally symmetrical hollow body and the opposite surface of the portion which is smaller in diameter and the passage openings are constituted by the spaces between the ribs. This embodiment comprises a skeleton, by which the rotationally symmetrical hollow body is adequately supported, e.g., by the radial ribs, and there are openings for the passage of the material to be mixed from one mixing vessel or mixing stage to another.

In a preferred embodiment, alternate connecting arms which carry the mixing blades are straight-lined and curved in V-shape, respectively. This design eliminates the need for additional connecting means at the rotationally symmetrical hollow body, particularly at its transition to the mixing vessel; such additional connecting means would adversely affect the mixing operation and the transfer of material from one mixing vessel to another.

Four identically designed mixing vessels are suitably connected to form an overall assembly, a common cylindrical rotationally symmetrical hollow body and a common shaft are associated with each pair of mixing vessels, the connecting arms which carry the mixing blades are secured by means of shock absorbers to the opposite ends of the common shaft, and said ends protrude over the cylindrical rotationally symmetrical hollow body. In spite of the use of a plurality of mixing vessels connected in series in that embodiment, the design will be so simplified as regards the bearing means and the drive means for the mixing blades that the existing components can perform a plurality of functions at the same time, based on their basic design. The bearing means for each shaft may be simplified in that the shaft is required to be rotatably supported by bearings only at its two outer ends disposed in the common cylindrical rotationally symmetrical hollow body.

Illustrative embodiments of the invention will now be explained more fully with reference to the accompanying drawings, in which

Figure 1 is a front elevation showing a mixer according to the invention. The mixer comprises a simple mixing vessel and constitutes a vehicle, which is partly shown in section so that the structure inside the mixing vessel becomes more clearly apparent.

Figure 2 is a top plan view showing the mixing

vessel and showing diagrammatically the arrangement of the mixing blades;

Figure 3 shows a first embodiment of bearing means for a rotatable connecting arm which carries the mixing blades;

Figure 4 shows as an alternative to Figure 3 separate means for driving the connecting arm which carries the mixing blades;

Figure 5 shows another embodiments of the bearing means for a rotatably mounted connecting arm which carries the mixing blades;

Figure 6 shows another embodiment of bearing means for a rotatably mounted connecting arm which carries the mixing blades; in this embodiment the mounting means are self-supporting and arranged in the interior of the mixing vessel.

Figure 7 shows an embodiment of a mixer comprising a plurality of mixing vessels connected in series;

Figure 8 is a sectional view taken on line VIII-VIII in Figure 7 and

Figure 9 shows an alternative embodiment of a mixer comprising a plurality of mixing vessels connected in series.

The basic concept underlying the invention will now be explained more fully with reference to Figures 1 and 2. For the sake of clearness, the explanation will be given with reference to a mixer vehicle 1, which comprises a single mixing vessel 2. The mixing vessel is carried by a chassis 3, which is supported on the ground, e.g., by means of wheels 4 and locking stays 5. The mixing vessel 2 is pivoted by means of a carrier 7 on a horizontal pivot 6. In the embodiment shown in Figure 1, the axis of the horizontal pivot 6 coincides with the axis of a drive shaft 8, which imparts rotation to the mixing vessel 2 by a pinion 9, which meshes with a bear ring 10, which extends around the entire periphery of the mixing vessel 2. The chassis is provide with two spaced apart vertical supports 11 and 12, which support the horizontal pivot 6 and drive shaft 8 and between which the carrier 7 and the mixing vessel 2 are disposed. A drive motor 13 is connected to the drive shaft 8. A hand lever 14 for adjusting the angular position is provided on that end of the carrier 7 which is remote from the drive motor 13 and comprises a pin 16, which cooperates with a locking device 15 by which the hand lever can be fixed in a plurality of positions, each of which is preferably defined by a groovelike recess 17, which receives the pin 16 of the hand lever 14 when the associated angular position has been reached.

The mixing vessel 2 is drum-shaped and comprises a bottom 20 and a shell or side wall 21, and is formed at its top with an opening 22 for charging and discharging. The center line of the mixing vessel 2 is designated 23. In accordance with the invention, a rotationally symmetrical hollow body 24, which in the present embodiment consists of a cone, is secured to the bottom 20 of the mixing vessel 2 and concentric to the center line 23 of the mixing vessel 2. As is apparent from Figures 1 and 2, two mixing blades 25 are provided in the interior of the mixing vessel 2 and are interconnected by a common V-shaped connecting arm 27, which is preferably made from flat bar stock. The mixing blades 25 and 26 are secured by screws to the ends of the connecting arm 27. A mixing blade carrier 29 is secured to the bottom of the V-shaped curved connecting arm 27 is disposed approximately vertically over the apex of the conical, rotationally symmetrical hollow body 24. The mixing blade carrier 29 is arcuately curved and extends through the opening 22 at the top of the mixing vessel 2. The mixing blade carrier 29 constitutes also an extension of the carrier 7 for the mixing vessel and is connected to the carrier 7 adjacent to the horizontal pivot 6, with a shock absorber 30 interposed. The shock absorber 30 consists preferably of a member having rubberlike elasticity. In the mixer 1 shown in Figure 1, the mixing blades 25 and 26 are stationary and the mixing vessel 2 is mounted for rotation about its center line 23 in a diagrammatically indicated bearing 31.

The arrangement and design of the mixing blades 25 and 26 will now be explained more fully with reference particularly to Figure 2. The mixing blade 25 is disposed near the outside surface of the rotationally symmetrical hollow body 24 and of the bottom 20 of the mixing vessel 2. The mixing blade 26 is disposed near the inside surface of the mixing vessel 2. An outer edge 32 of the mixing blade 25 disposed near the outside surface of the rotationally symmetrical hollow body 24 includes an angle of about 45° with a plane 36 which extends through both mixing blades 25, 26 and the center line 23 of the mixing vessel 2. That inner edge 33 of the mixing blade 25 which faces the rotationally symmetrical hollow body 24 is inclined and is only slightly spaced from the outside surface of the rotationally symmetrical hollow body 24 near the bottom 20 of the mixing vessel 2. An inner edge 35 of the mixing blade 26 disposed near the inside surface of the mixing vessel 2 includes an angle β of about 120° with the plane 36 that extends through the mixing blades 25 and 26 and the center line 23 of the mixing vessel 2. The outer edge 34 of the mixing blade 34 faces the inside surface of the mixing vessel 2 and includes an angle α of about 23° with a tangent to that inside surface.

The mode of operation of a first embodiment of a mixer 1 according to the invention will now be explained.

Rotation is imparted to the single mixing vessel 2 by means of the drive motor 13, the drive shaft 8 and the opinion 9, which meshes with the gear ring 10 on the mixing vessel 2, which is thus rotated, e.g., in a clockwise sense. The material being mixed is entrained by the mixing vessel and is reversed and pushed in the direction from the rotationally symmetrical hollow body 24 toward the inside surface of the mixing vessel 2 by means of the mixing blade 25. This is accomplished owing to the arrangement of the mixing blades 25 and 26 in positions defined by the angles α, β and γ. The inclined mixing blade 26 reverses the material to be mixed and pushes it from the inside surface of the mixing vessel 2 toward the center, i.e., toward the rotationally symmetrical hollow body 24. As the material to be mixed moves from the inside surface of the mixing vessel 2 to the rotationally symmetrical hollow body 24, the material being mixed again contacts the bottom 20 of the

mixing vessel 2 and is once more entrained by the rotation of the mixing vessel 2. This results in a much more intense mixing as before so that the mixing operation can be terminated after a much shorter time and an extremely high degree of mixing is surprisingly achieved. By the selection of the number of mixing blades and of the angles α, β and γ defining their orientation, the mixing operation can be controlled within such a wide range of conditions that almost all conceivable combinations can be obtained and almost all conceivable requirements can be fulfilled. Because the mixing will be influenced also by the angle of inclination of the mixing vessel relative to the horizontal axle 6 if, in accordance with the invention, a rotationally symmetrical hollow body 24 and mixed blades 25 and 26 are provided, the mixing vessel 2 can be locked by the locking device 15 not only in the horizontal bormal position and a discharging position, which is approximately at right angles to the basic position, but also in a number of additional positions, in which the pin 16 provided on the hand lever 14 can engage the locking device 15. As a result, in a mixer embodying the invention the inclination of the mixing vessel 2 may also be adjusted in order to improve the quality of the mixture and the degree of mixing.

Preferred embodiments of bearing means for rotatably mounting a connecting arm 27 to which mixing blades 25, 26 are secured will be explained with reference to Figures 3 to 6; these mixing blades are stationary in the embodiment shown in Figures 1 and 2.

A connecting arm 41 is diagrammatically indicated in Figure 3 and at its ends carries the mixing blades 25, 26, not shown, and is secured to one end of a shaft 40 with a shock absorber 42 interposed. The shaft 41 extends approximately at right angles to the bottom 20 of the mixing vessel 2. In this embodiment the rotationally symmetrical hollow body 24 consists of a conical tubular member, which is secured to the bottom 20 of the mixing vessel 2, e.g., by welding. The shaft 40 extends through the rotationally symmetrical hollow body 24 and protrudes over the ends of the latter. The connecting arm 41 is secured to one of the protruding ends of the shaft 40, e.g., by means of a screw 43, with the shock absorber 42 interposed. In the embodiment shown in Figure 3, the shaft 40 extends through the main bearing 31 for the mixing vessel. That bearing 31 is secured to the carrier 7 for the mixing vessel. The shaft 40 extends through the bearing 31 of the mixing vessel 2 and is secured behind the bearing 31 to a U-shaped strut, both ends of which are secured to the carrier 7 for the mixing vessel at points which are approximately symmetrical to the bearing 31. If the connecting arm 41 is rotatably mounted by means of a shaft 40, as shown in Figure 4, the shaft 40 may be separately driven by a speed-reducing transmission, which is diagrammatically indicated at 45 and secured to the carrier 7 for the mixing vessel. The shaft 40 in Figure 4 extends also through the main bearing 31 of the mixing vessel 2. In the present embodiment, that main bearing consists of a hub, which is directly secured to the bottom 20 of the mixing vessel 2. The shaft 40 is rotatably mounted in a sleevelike insert 47, which is provided between the hub 46 and a ball bearing 48. In the present embodiment, the rotationally symmetrical hollow body 24 is conical and consists, e.g., of a tubular member, which is secured to the bottom 20 of the mixing vessel 2, e.g., by welding. In the embodiment shown in Figure 4, the connecting arm 41 is also secured with a shock absorber 42 interposed, although this is not shown.

A difference from the embodiment shown in Figure 3 resides in that the shaft 40 is shorter and in the embodiment shown protrudes only slightly over the bottom 20 of the mixing vessel 2. In other respects, the bearing is substantially similar in design to that described with reference to Figure 3. In the present embodiment, the mixing blades 25, 26 are carried by the connecting arm 41′, which is straight-lined whereas the connecting arm 41 of Figure 3 is curved in V-shape.

Figure 6 shows another embodiment of bearing means for a connecting arm 41″, which carries mixing blades 25 and 26. In the embodiment shown in Figure 6, the shaft 40″ is self-supporting and disposed in the interior of the mixing vessel 2. The connecting arm 41″ is secured to the end of the shaft 40″ with a shock absorber 42 interposed. Just as in the embodiment shown in Figure 5, the connecting arm 41″ is straight-lined and at opposite ends carries the mixing blades 25 and 26. In the embodiments shown in Figures 5 and 6 the rotationally symmetrical hollow body secured to the bottom 20 of the mixing vessel 2 is not shown.

Two embodiments of a so-called process mixer 50 will now be explained with reference to Figures 7 to 9. The mixer 50 comprises a plurality of mixing vessels 51, 52, 53, 54, which are connected in series and interconnected by passage openings 55.

A first embodiment of such a multistage or process mixer 50 will be explained more fully with reference to Figures 7 and 8. Four mixing vessel 51, 52, 53, 54 are provided, which at opposite ends have flange-like portions, such as 56 and 57, which are smaller in diameter and firmly interconnected by screws 58. Four identical ones of such mixing vessels 51 to 54 are joined to form an overall arrangement. A common rotationally symmetrical hollow body 60 is associated with each of the pairs 51, 52 and 53, 54 of mixing vessels and in the present embodiment of the mixer 50 is cylindrical. A shaft 61 is disposed in the interior of the cylindrical rotationally symmetrical hollow body 60 associated with each pair 51, 52 or 53, 54 of interconnected mixing vessels and is also associated with said pair of mixing vessels 51, 52 or 53, 54 and rotatably mounted in two spaced apart bearings 62, 63 in the interior of the cylindrical rotationally symmetrical hollow body 60. The two ends of the common shaft 61 protrude from the cylindrical rotationally symmetrical hollow body 60 and the connecting arms 64, 65 which carry mixing blades 67, 68 are secured to said ends with shock absorbers interposed. The connecting arm 64 disposed in one mixing vessel 51 of the pair 51, 52 is straight-lined. The connecting arm 65 disposed in the other mixing vessel 52 of the same pair is bent in hat shape and at its free ends carries the mixing

blades 67 and 68. Radial ribs 69 shown more clearly in Figure 8 are provided at the junction between two mixing vessels 51, 52 and are secured to the cylindrical rotationally symmetrical hollow body 60 and to the opposite wall of the end portions 56, 57 which are smaller in diameter. These radial ribs 69 serve to support the cylindrical rotationally symmetrical hollow body 60 at the junction between two mixing vessels 51, 52, and the spaces between the ribs 69 constitute the passage openings 55. The remaining pair of mixing vessels 53, 54 are designed substantially like the pair of mixing vessels 51 and 52 and need not be described more in detail.

Rotation is imparted to the outside to the mixer 50 which is shown in Figure 7 and comprises the four mixing vessels 51, 52, 53, 54. The driving torque is transmitted by a chain in mesh with a chain sprocket 71, which is preferably mounted at the junction between two mixing vessels 53, 54. In this embodiment, the shafts 61 are supported by a carrying frame at least at their outer ends 72, 73. This carrying frame 74 may carry also the motors for driving the shafts 61. Separate drive motors are preferably provided for that purpose or the drive may be derived from a driven shaft, e.g., of a vehicle.

The mixing blades 67, 68 may be rotated in the sense which is opposite to the sense of rotation of the mixing vessels 51, 52, 53, 54 or in the same sense. The speeds of the shafts 61 and of the mixing vessels 51 to 54 may be different and the speeds of the shafts for e.g., two interconnected mixing vessels may also be different so that an adaptation to existing conditions and to the properties of the materials to be mixed is permitted. These properties will also determine the number of mixing vessels 51 to 54, which are connected in series.

Figure 9 shows an alternative embodiment of a mixer 50, which comprises a plurality of mixing stages or cylindrical mixing vessels 76 to 78. A common cylindrical rotationally symmetrical hollow body 79 extends through all three cylindrical mixing vessels 76 to 78. Such an assembly 50 consists of a plurality of mixing vessels 76, 77, 78 is preferably made from a cylindrical main body in that the interior of the latter is divided by transverse partitions 80, 81, 82 into a plurality of chambers or mixing vessels 76, 77, 78, which constitute the several mixing stages. In this embodiment, mixing blades 67 and 68 are provided in each mixing vessel 76 to 78 and carried by connecting arms 64, 65.

Shock absorbers are provided in the various embodiments of the invention in order to amount the connecting arms and the mixing blades carried by them in such a manner that they will not be damaged but can yield as they approach the bottom of the mixing vessel or impinge on obstacles.

CLAIMS

1. A mixer having at least one drum-shaped mixing vessel, which is mounted for rotation about its center line in a bearing on a carrier, a mixing mechanism disposed in the interior of the mixing vessel, a rotationally symmetrical hollow body disposed in the interior of the mixing vessel on the bottom thereof and concentric to the center line of the mixing vessel, at least one mixing blade disposed near the outside surface of the rotationally symmetrical hollow body and near the bottom of the mixing vessel, and at least one additional mixing blade disposed near the inside surface of the mixing vessel.

2. A mixer according to claim 1, wherein the mixing blades are interconnected by a common connecting arm.

3. A mixer according to claim 1 or claim 2, wherein the connecting arm consists of a single piece of flat bar stock.

4. A mixer according to any one of claims 1 to 3, wherein the two mixing blades are secured to the connecting arm.

5. A mixer according to any one of claims 1 to 4, wherein the outer edge of the mixing blade disposed near the outside surface of the rotationally symmetrical hollow body includes an angle of about 45° with a plane which extends through both mixing blades and the center line of the mixing vessel.

6. A mixer according to any one of claims 1 to 5, wherein the inner edge of the mixing blade disposed near the inside surface of the mixing vessel includes an angle of about 120° with a plane which extends through both mixing blades and the center line of the mixing vessel.

7. A mixer according to any one of claims 1 to 6, wherein the mixing blades disposed in the mixing vessel are stationary.

8. A mixer according to claim 7, wherein the rotationally symmetrical hollow body consists of a cone, which is secured to the bottom of the mixing vessel, and the common connecting arm which carries the mixing blades is curved in V-shape and at its bottom is secured to a blade carrier, which constitutes an arcuately curved extension of the carrier for the mixing vessel.

9. A mixer according to claim 8, wherein the carrier for the mixing vessel is mounted the machine frame to be pivotally movable together with the mixing vessel on a horizontal pivot.

10. A mixer according to claim 9, wherein the axis of the horizontal pivot coincides with the axis of the drive shaft for rotating the mixing vessel, and a pinion is fixed to the drive shaft and in mesh with a ring gear that extends around the outside periphery of the mixing vessel.

11. A mixer according to claim 9 or claim 10, wherein the arcuate blade carrier is connected to the carrier for the mixing vessel adjacent to the horizontal pivot with a shock absorber interposed.

12. A mixer according to any one of claims 9 to 11, wherein the angular position of the carrier for the mixing vessel is variable by means of a lever, which is connected to the horizontal pivot and adapted to be locked in a plurality of positions.

13. A mixer according to any one of claims 1 to 6, wherein the mixing blades are rotatably mounted by means of the common connecting arm on a shaft which is at right angles to the bottom surface of the mixing vessel.

14. A mixer according to claim 13, wherein the shaft extends through the rotationally symmetrical hollow body and protrudes over its end, and the connecting arm is secured to the end with a shock absorber interposed, which consists preferably of a

rubber element.

15. A mixer according to claim 13 or claim 14, wherein the rotationally symmetrical body consists of a conical tube member.

16. A mixer according to any one of claims 13 to 15, wherein the mixing blades are separately driven and the shaft is supported adjacent to the bearing for the mixing vessel by a bearing which consists of a hub of the mixing vessel and at the other end by a bearing disposed in the rotationally symmetrical hollow body.

17. A mixer according to claim 16, wherein the shaft is drive by a speed-reducing transmission.

18. A mixer according to any one of claims 14 to 17, wherein the connecting arm is curved in hat-shape and carries the mixing blades at its ends.

19. A mixer according to any one of claims 14 to 17, wherein the connecting arm is straight-lined.

20. A mixer according to claim 13, wherein the shaft which carries the common connecting arm and the mixing blades secured thereto is self-supporting and disposed in the interior of the mixing vessel and the connecting arm is mounted on the shaft, with a shock absorber interposed.

21. A mixer according to any one of claims 1 to 6, wherein a plurality of mixing vessels are connected in series and interconnected by openings, a common cylindrical, rotationally symmetrical hollow body extends through at least two successive mixing vessels, and a shaft is rotatably mounted inside said body and carries at least two connecting arms provided with the mixing blades and is rotatably supported by means of bearings in the cylindrical rotationally symmetrical hollow body.

22. A mixer according to claim 21, wherein the shafts associated with all mixing vessels connected in series are supported at least at their outer ends by a carrying frame.

23. A mixer according to claim 21 or claim 22, wherein rotation is imparted from the outside to the assembly consisting of a plurality of mixing vessels.

24. A mixer according to claim 23, wherein a chain is provided for transmitting torque.

25. A mixer according to any one of claims 21 to 24, wherein the shaft(s) is or are separately driven.

26. A mixer according to any one of claims 21 to 25, wherein the mixing vessels are cylindrical and the cylindrical rotationally symmetrical hollow body extends through all mixing vessels.

27. A mixer according to claim 26, wherein the plurality of mixing vessels are defined by transverse partitions, which are provided with passage openings adjacent to the cylindrical rotationally symmetrical hollow body.

28. A mixer according to any one of claims 21 to 25, wherein the mixing vessels at their opposite ends comprise flange like portions which are smaller in diameter and firmly interconnected by screws.

29. A mixer according to claim 28, wherein the cylindrical rotationally symmetrical hollow body is supported at the joint between two mixing vessels by radial ribs, which are secured to the cylindrical rotationally symmetrical hollow body is supported at the joint between two mixing vessels by radial ribs, which are secured to the cylindrical rotationally symmetrical hollow body and the opposite surface of the portion which is smaller in diameter and the passage openings are constituted by the spaces between the ribs.

30. A mixer according to claim 28 or claim 29, wherein the connecting arms which carry the mixing blades are straight-lined and curved in V-shape or hat shape, respectively.

31. A mixer according to any one of claims 28 to 30, wherein four identically designed mixing vessels are suitably connected to form an overall assembly, a common cylindrical rotationally symmetrical hollow body and a common shaft are associated with each pair of mixing vessels, the connecting arms which carry the mixing blades are secured by means of shock absorbers to the opposite ends of the common shaft, and said ends protrude over the cylindrical rotationally symmetrical hollow body.

32. A mixer according to claim 31, wherein each shaft is rotatably supported in bearings only at its two outermost ends disposed in the interior of the common cylindrical rotationally symmetrical hollow body.

33. A mixer substantially as hereinbefore described with reference to Figures 1 and 2 as modified or not by any one of Figures 3 to 6, Figures 7 and 8 or Figure 9 of the accompanying drawings.

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